Research priorities for MOU - Please review and comment

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Keara,
I talked and included comments and feedback received from Nancy, Ken, and Rob. Following the extensive literature survey completed by the NTW, R6 would recommend research with practical applications such as those research needs suggested in the NTW report below. NTW did not imply there should be more data collection because of the impracticality of such a request, but to use existing data or request additional data in only those specific areas determined appropriate by the Director. The NTW recommendations for research related to geologic siting for disposal zone areas with limited to no existing data is not really an option in the proposed existing research topics.

The MOU research topics do not contain an assessment of the information gap that should be the first order of business and then research needs identified. Nancy identified the following: For example, the *Seismological Research Letters* Volume 81, Number 2 March/April 2010 discussed a debate held by the leading seismological experts at their annual 2010 meeting:

Earthquake Debates
Invited speakers will debate important issues in earthquake science. Such issues include the predictability of earthquakes, the distribution of earthquake sizes on major faults, the role of Coulomb stress change in earthquake triggering, and many others. The predictability debate has been with us for decades and is based on many of the contentious issues debated in this session. Speakers will debate what earthquake prediction really means, how it can be evaluated, and whether it is realistic for scientists to promise progress to funding agencies or the public. The issue of earthquake size is often distilled into two limiting hypotheses: characteristic or Gutenberg-Richter distribution. Does Gutenberg-Richter behavior in a large region imply similar behavior on individual faults, and how do we decide when earthquakes are on individual faults anyway? Earthquakes and stress must (?) influence each other, but how? Do static effects of large earthquakes cause Coulomb stress shadows and bright spots, or do dynamic effects dominate earthquake triggering, or something else? Other issues like earthquake periodicity, limits on earthquake size, precarious rocks as seismometers, and limits on strong ground motion are equally contentious.
Conveners: Danijel Schorlemmer (ds@usc.edu), David D. Jackson (djackson@ess.ucla.edu), Warner Marzocchi (marzocchi@NOSPAMingv.it), Jeremy D. Zechar (jeremy.zechar@sed.ethz.ch)

Of the six research needs in the MOU, we listed our priorities with some

caveats in order of preference with the proviso that more immediate issues should come first as noted below.

3. Model development to forecast likelihood, location, and magnitude of induced seismic events

Other difficulties that need to be addressed to allow the model a chance of reasonable success:

Most seismicity felt at the surface appears to be occurring along previously unidentified faults.

How will these models differ from the existing USGS hazard ground motion maps?

1. Dynamic Gap Assessment

6. Hazard and Risk Assessment–Develop tools for generating Probabilistic Seismic Hazard and Risk Assessments for shale gas production field sites

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Research needs identified in NTW report: **Research Needs**

The WG did not exhaust all avenues with respect to research on the value of petroleum engineering approaches. An abundance of research describing seismology and geomechanical behavior in the form of physical rock properties exists although studies that combined petroleum engineering and geoscience approaches could not be found by the WG. The WG recommends future practical research using a multidisciplinary approach and a holistic assessment addressing disposal well and reservoir behavior; geology; and area seismicity. Such an approach would benefit from combined expertise in geology, petroleum engineering, geophysics and seismology, which may not be available through one entity. For example, areas of expertise should include, but may not be limited to structural and stratigraphic geology; rock mechanics; seismology; reservoir characterization; reservoir fluid flow mechanisms; and disposal well construction, completion and performance.

The WG employed Hall plots for the reservoir engineering analysis because regulators may perform the analysis using widely available spreadsheet software; however, other approaches exist, such as the Reciprocal Productivity Index that

may be applicable if inverted to injection conditions. WG recommends a practically applied research project focused on assessment of injection well operating data to determine if there is a correlation between operating well behavior and seismicity. One of the key outcomes of the project would be a practical set of methodologies to assess operating data (templates) using injection well operating data acquired for existing UIC permits.

There is also a need for research related to geologic siting criteria for disposal zones for areas with limited or no existing data. The geologic and geophysical study could focus on stratigraphic horizons that could serve as disposal zones in these areas, the nature of subsurface stresses in basement rocks of these areas, and a more detailed regional geological assessment of basement faults. If sufficient earthquake catalog data are available, additional research to devise a statistical approach to relate Class II disposal wells operating parameters with induced seismicity would be useful.